Estimated Carbon Absorption and Economic Benefits in Various Scenarios of Community Forest (HKm) Land Management Through The Scheme of Plan Vivo in The Upstream Watersheds (DAS) of Renggung River, Central Lombok Regency, Indonesia

L. Sukardi[1] , Ismail[2] and M. Husni Idris[3]

[1] Universitas Mataram, Indonesia
[2] Universitas Mataram, Indonesia, [3] Universitas Mataram, Indonesia
Email: kardi_64@yahoo.com

Abstract

This study aims to (1) estimate carbon absorption and the economic benefits of HKM land management through Plan Vivo scheme and (2) determine the composition of plants to be prioritised. This research was conducted in the upstream watershed of Renggung River in Central Lombok. The calculation of the estimated carbon absorption was obtained using allometric equations, while the estimated economic benefits were calculated from the production of commodities that are grown and the potential of carbon trading. To determine the prioritised scenarios, Analitycal Hierarchy Process (AHP) was conducted. The time range of analysis is conducted within a period of 15 years with three scenarios of composition of plants : (1) scenario-1: 70% MPTs and 30% timber trees (2) scenario-2: 30% MPTs and 70% timber trees; and (3) scenario-3: 50% MPTs and 50% timber trees. The results of the study are as follows: (1) the increased absorption of carbon dioxide (CO_2) for scenario-1 amounted to 87.54 tonnes/ha/yr, scenario-2 amounted to 138.93 tons/ha/yr, and scenario-3 for 113.88 ton/ha/yr; (2) The economic benefits for the scenario 1 is of IDR 37,882,304,- /hectare/year, the scenario-2 of IDR 22,875,951,- per hectare / year, and scenario-3 of IDR 31,685,853,- per hectare/year. Furthermore, based on the consideration of carbon absorption, economic benefits, and sociocultural aspects, the priorities to be developed is the scenario-2.

Keywords: Estimation, Carbon Absorption, Plan Vivo, Renggung River Watersheds

Introduction

Today's land management is emphasised on the concept of sustainable land management. The paradigm of sustainable land management implies that in fulfilling our current needs, today's management trends must not reduce the ability of natural resources to meet the needs of future generations. The concept of sustainable land management is expected to accommodate the economic benefits and environmental conservation aspects to realize a balance between human needs and nature conservation (Sudirman, 1995). In reality, the practice of today's land management today is still far from its intended sustainable concept. Nationally and internationally, the spotlight is now directed upon the management of the forestry sector. In this respect, we still deal with the unjustified management of forest which causes deforestation and land degradation which in turn have been having negative impacts on the environment. One of the environmental consequences of bad land management is the loss or reduced ability of the land to perform the carbon absorption on the landscape (Lamb, 1994).

One of the efforts that have been made to bridge the issue of land management that not only provides economic benefits but also regards the aspect of environmental conservation is through the mechanism of environmental services. Environmental service is the concept of providing incentives to public land managers who are able to produce environmental services such as water, carbon, tourism, and natural diversity. One scheme of environmental service that is oriented to improve people's livelihoods and improve environmental sustainability is Plan Vivo Standard. Plan Vivo is a reward mechanism that makes the value of a forest carbon absorption as an indicator to pay an incentive to the community of land managers (Plan Vivo Standards, 2012).

Currently, the Plan Vivo has been implemented on the land management of community forest (HKM) in the area of the upstream watersheds of Renggung River in Central Lombok through reforestation activity of 7 (seven) timber tree species to the size of 290 trees / ha, consisting of one (1) timber species of Rajumas (Duabanga) and 6 (six) frut producing trees; mangosteen, avocado, soursop, lanzones and sapodilla . This study aims to: (1) estimate the carbon absorption and the economic benefits of HKm land management through Plan Vivo scheme and (2) determine the priority of plants compositions to be developed.

Method

This research was conducted at the HKM in the upstream watersheds area of Renggung River administered by the local government of Aik Bual Village, Kopang District, Central Lombok Regency.
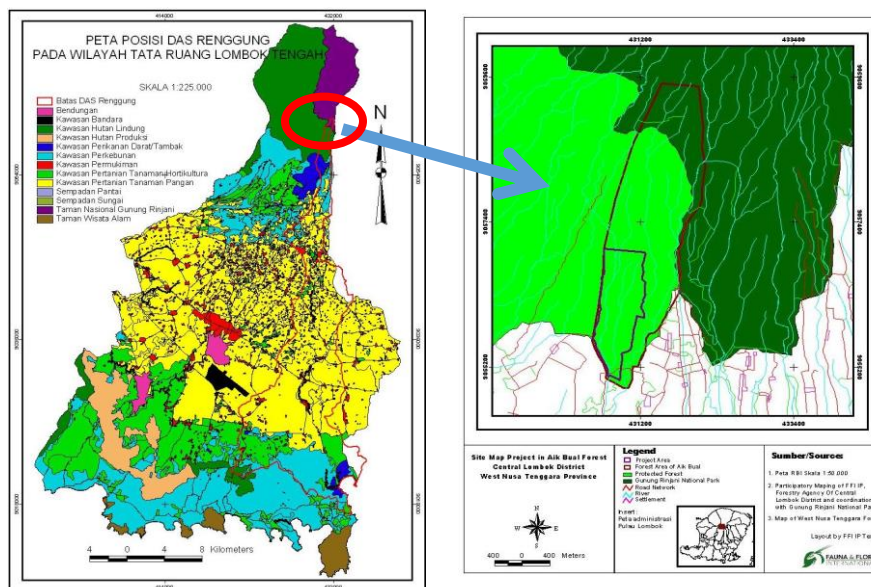
Figure 1. Research Location in the Upstream Watersheds Area of Renggung River

The data collection was conducted through observation, interviews, and focus group discussion (FGD). In this study, to estimate the carbon absorption and economic benefits, the researcher did 3 (three) scenarios of composition of plants, namely:

1. Scenario-1 with a composition of 70% of fruit trees (MPTs) and 30% of timber trees. This scenario is favoured by the community which is more oriented to the economic benefits.
2. Scenario-2 with a composition of 30% of fruit trees (MPTs) and 70% of timber trees. This scenario is to accommodate the government regulations on HKm, which is more enviromentally oriented (carbon absorption)

3. Scenario-3 with a composition of 50% of fruit trees (MPTs) and 50% of timber trees. This is considered as the middle way to birdge the needs for the community to gain the economoc benefits and government's agenda to preserve the environement.

Estimation of carbon absorption is calculated using by using the formula (Kemenhut, 2012) as follows:

*Absorption of carbon dioxide (CO₂ Eq) = total carbon stocks x 3.67*

Carbon stocks are calculated using the biomass approach, where the reserved carbon stored in the form of biomass can be determined by multiplying the carbon friction constant of the biomass to the amount of 0.47 (Hutabarat, 2013). The economic benefits are calculated based on the predictive value of production which will be gained from the cultivation of seven (7) types of trees planted for Plan Vivo scheme. For prioritization of 3 (three) plant composition scenarios approach in Vivo Plan Scheme, the method of Analytical Hierarchy Process (AHP) was carried out (Saaty, 1993; Marimin, 2004). In this case, there are three (3) aspects that form the basis of considerations, namely: the rate of carbon absorption, economic benefit, and socio-cultural aspects.

Results and Discussion

HKm land conditions in the upstream watersheds area of Renggung River in Central Lombok today (without any intervention of Plan Vivo scheme) has a tree cover density of 110 trees per hectare. It has an absorption of carbon (CO2) emissions by 284.90 tons / ha / year and within the next 15 years is estimated to have the absorption of carbon (CO2) emissions by 561.22 tons / ha / year or on average, there is an increase of 37, 41 tonnes / ha / th. Meanwhile, the economic benefits generated by the current condition of such land is at the amount of Rp.4.363.716, - / year / ha (Fauna & Flora International, 2013).

Estimated Carbon Absorption

The activities of planting seven types of trees with the number of 290 trees / ha result in the different increase of sequestration of carbon dioxide (CO2) among the three plant composition scenarios. The analysis showed that in 15 year period, the increased absorption of carbon dioxide (CO2) are as follows (1) scenario-1, an increase of 1313.19 tons / ha or at the average of 87.54 tonnes / ha / yr, (2) scenario 2 of 2.083,97ton / ha or amounted to 138.93 tons / ha / yr, and (3) a scenario-3 for 1.708,27ton / ha or amounted to 113.88 tonnes tonnes / ha / yr. More complete description on the absorption of carbon dioxide (CO2) in each scenario is presented in Figure 2.
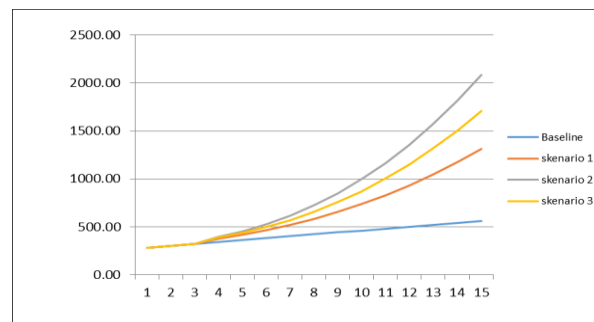

Figure 2. Estimated Carbon Absorption in Each Scenarios of Plan Vivo

For the criteria of carbon absorption, scenario 2 is the scenario that generates the highest carbon absorption compared to two other scenarios. This is because the composition of plants in scenario 2 is 70% timber trees. This is in accordance with ICRAF study (2012) that the timber tree has the ability to absorp carbon relatively higher than other types of trees

Estimated Economic Benefits

The economic benefits are estimated from the production of grown commodities (the sale of fruits) and the estimated values of carbon trading. In this case, the value of carbon trading is obtained by multiplying the additional absorption of carbon per year generated by the price of per ton of carbon in the carbon trading market, where the price of carbon is US $ 5 per ton. From the analysis, the description of estimated economic benefits through the implementation of the Plan Vivo scheme for a period of 15 consecutive years are as folloes: (1) scenario-1, IDR 568,7234,566,-/ha or an average of IDR 37,882,304,-/ha/year, (2) skenario -2 of IDR 343,140,769,-/ha or an average of IDR 22,876,051,-/ha/yr, and (3) scenario-3 of IDR 475,287,798,-/ha or an average of IDR 31,685,853,-/ha/yr. More details on the economic benefits of estimated growth in each scenario is presented in Figure 3.
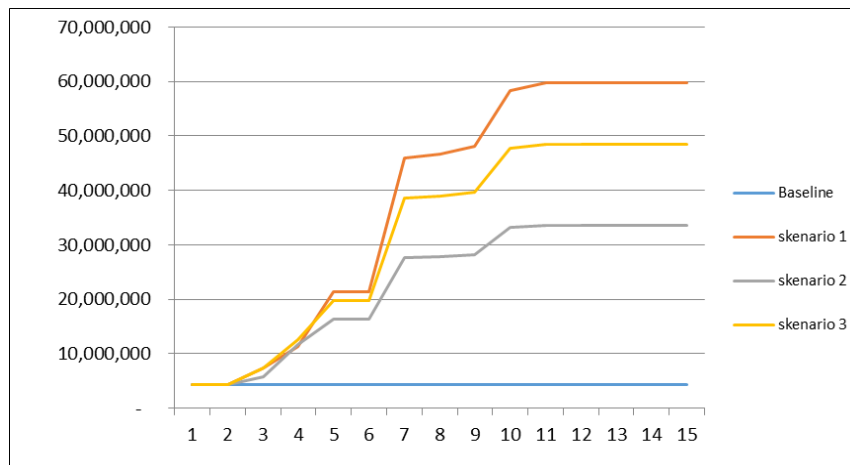

Figure 3. Estimated Economic Benefits of Plan Vivo Scenario

For the economic criteria, scenario 2 is the scenario that provides the highest economic benefits, due to the considerably higher economic benefits from the fruit producing trees which takes up to 70% of the planted trees.

The Priority of Plants Compositions Scenario

To determine the order of priorities for the application of trees planting in Plan Vivo scheme was done through Analityc Hierarchy Process (AHP). The criteria which was used to determine the priority order of planting composition scenarios are: (1) absorption of carbon, (2) economic benefits, and (3) socio-cultural aspects. The results of the analysis of priority is presented in Figure 4.
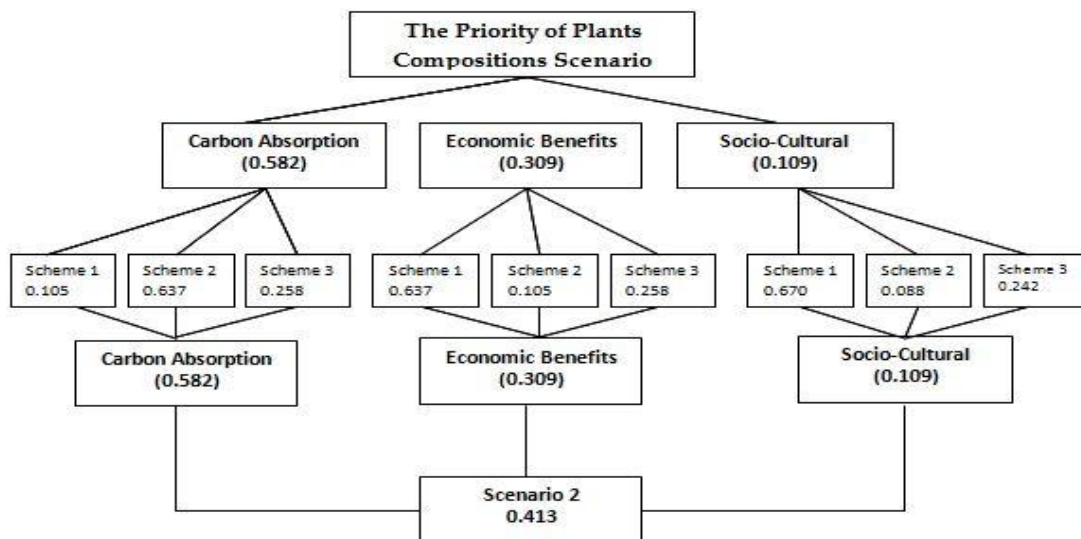
Figure 4. The Priority of Plants Composition Scenario in Plan Vivo Scenario

Based on the analysis of AHP, it was found that the most important aspect in the implementation of the Plan Vivo is the absorption of carbon by the weight of 0.582, followed by the aspect of economic benefits to the weight of 0.309, and the socio cultural aspect with the weight of 0.109. This shows that the criteria of carbon absorption has considerable influence in determining the priorities. From Figure 4 it can be seen that scenario that becomes the the main priority varies depending on the criteria used. According to the criteria of carbon absorption, the top priority is the scenario-2, followed by a 3-scenarios, and scenario-1. Based on the criteria of economic benefits, the top priority is the scenario-1, followed by scenario -3, and scenario-2. Based on the socio-cultural criteria, the top priority is the scenario-1, followed by a 3-scenarios, and scenario-2. Seen from these three criteria, as a whole, so that the first priority is the scenario-2, followed by scenario 1 and scenario-3. By looking at the order of priority, where scenario two (2), which is the policy of the government with a composition of 70% timber tree and 30% fuit trees, showed that the policy implemented so far is not only concerned with environmental aspects alone, but also be able to accommodate the aspects of economic benefits and socio-cultural aspects.

Conclusions

The Plan Vivo Scheme in the upstream watersheds of Renggung River can increase absorption of carbon dioxide (CO2) respectively by: (1) scenario-1 (70% MPTs and 30% timber trees) amounted to 87.54 tonnes / ha / yr, (2) scenario- 2 (30% MPTs and 70% timber trees) amounted to 138.93 tons / ha / yr, and (3) the scenario-3 (50% MPTs and 50% timber trees) amounted to 113.88 tonnes tonnes / ha / yr. The economic benefits through the implementation of the Plan Vivo scheme, respectively: (1) scenario-1 of IDR 37.882.304, -/ha/yr, on the average (2) skenario-2 of IDR 22.876.051, - / ha / yr, and (3) scenario-3 of IDR 31.685.853, - / ha/yr. Based on the consideration of criteria for carbon absorption, economic benefits, and sociocultural impact, the priority of implementation of Plan Vivo Scheme is the scenario-2, followed by scenarios 1 and scenario-3. Scenario-2 with a composition of 70% of timber trees and 30% of MPTs which is the priority in the scheme of Plan Vivo is not really favoured by the community, who want the opposite composition. Therefore, there is a need for dissemination and empowement for the people in this area.

Reference

Arifin. J. (2001). Estimasi cadangan C pada berbagai sistem penggunaan lahan di Kecamatan Ngantang. Malang. Skripsi-S1. Universitas Brawijaya. Malang

Fauna & Flora International. (2014). Community-Based Agroforestry for Upper Watershed Rehabilitation-Plan Vivo Project Idea Note (PIN). Jakarta

Hairiah.K.. and S. Rahayu. (2007). *Pengukuran Karbon Tersimpan di Berbagai Macam Penggunaan Lahan.* Bogor. Indonesia. World Agroforestry Centre-ICRAF.SEA Regional Office. Bogor. Indonesia

Hutabarat.dan Setiawan. (2013). Plan Vivo Technical Spesification. FFI-Indonesia Programme. Jakarta

ICRAF. (2012). Wood Density Database.Retrieved October 22. 2012

Lamb. D. (1994). Reforestration of Degraded Tripocal Forest Land in the Asia-Pasific Region. Journal of Tro[pical Forest Science

Marimin. (2004).Teknik dan Aplikasi Pengambilan Keputusan Kriteria Majemuk.Grasindo. Jakarta

Nazir M. (2005). Metode Penelitian. Ghalia Indonesia. Jakarta

Plan Vivo Standard. (2012). Plan Vivo Standard for Payment for Ecosytem Services Programme

Saaty, T.L. dan L.G. Vargas. (2006). Decision Making With The Analytic Network Process, Springer. United States of America

Soedirman, S. (1995). Tinjauan secara Komprehensif Pengelolaan Hutan Alam Produksi Lestari. Konsep dan Permasalahannya. Fak. Kehutnana IPB

L. Sukardi
Universitas Mataram, Indonesia Email: kardi_64@yahoo.com

Ismail
Universitas Mataram, Indonesia

M. Husni Idris
Universitas Mataram, Indonesia